

Controls & Instrumentation/Fossil Boilers
Project Specific Transmittal for LT AC motors and DC motors

Transmittal Ref.: TR:LT AC-DC MOTOR:1727

Project Details :

Project/Rating : BHUSAWAL TPP, 1 X 660 MW

Customer Number : 1727

Annexure to the technical specification of LT AC Motor and DC Motor

Energy efficient level: IE3 as per IS 12615 – 2011 (For LT AC Motors).

Table-1. Power cable size for LT AC motors:-

Vendor to provide the cable entry and supply cable-glands, lugs as per the technical specification requirement and suitable for the power cable sizes as indicated below. The cable sizes indicated below are tentative. The actual power cable size based on the run length will be intimated during technical evaluation stage.

Sl. No.	From (KW)	To (KW)	Power Cable size in sq. mm. (#)
1.	0.01	3.7	3C-2.5mm ² (CU)
2.	3.71	9.3	3C-10mm ² (AL)
3.	9.31	22	3C-25mm ² (AL)
4.	22.1	37	3C-50mm ² (AL)
5.	37.1	55	3C-95mm ² (AL)
6.	55.1	75	3C-150mm ² (AL)
7.	75.1	90	3C-240mm ² (AL)
8.	90.1	132	2-3C-240mm ² (AL)

Table-2 (applicable to LT AC, Flame proof Motors only) :-

Sl. No.	Motor rating (KW)	Minimum Distance between centre of motor terminal and the gland plate (mm)
1	Up to 3 KW	As per manufacturers' practice
2	Above 3 KW – Up to 7 KW	85
3	Above 7 KW – Up to 13 KW	115

4	Above 13 KW – Up to 24 KW	167
5	Above 24 KW – Up to 37 KW	196
6	Above 37 KW – Up to 55 KW	249
7	Above 55 KW – Up to 90 KW	277
8	Above 90 KW – Up to 125 KW	331

Table-3 Applicable for LT AC motors :-

Minimum inter-phase and phase-earth air clearance for LT AC motors with lugs installed shall be as follow

Sl. No.	Motor MCR in KW	Clearance (in mm)
1	Up to 110 KW	10
2	Above 110 KW – Up to 150 KW	12.5

Table-4 (Power cable size for DC motors) :-

Vendor to provide the cable entry and supply cable-glands, lugs as per the technical specification requirement and suitable for the power cable sizes as indicated below. The cable sizes indicated below are tentative. The actual power cable size based on the run length will be intimated during technical evaluation stage.

Sl. No.	Full Load current (Amp)	Power Cable, Armoured, Aluminium Conductor
1.	16	2C-50mm ² (AL)
2.	20	2C-50mm ² (AL)
3.	25	2C-50mm ² (AL)
4.	35	2C-95mm ² (AL)
5.	50	2C-95mm ² (AL)
6.	63	2R-2C-95mm ² (AL)
7.	80	2R-2C-95mm ² (AL)
8.	100	2R-2C-95mm ² (AL)

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 365 of 440
1.0 <u>SCOPE</u> 1.1 This section covers the general requirements of the drive motors for power station auxiliary equipment. 1.2 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification. 1.3 In case of any discrepancy, the driven equipment specification shall govern etc. 2.0 <u>STANDARDS</u> 2.1 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification. 2.2 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed (a) IS-325 (b) IS-12615 (c) IEC-34 3.0 <u>SERVICE CONDITIONS</u> 3.1 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash canopy to be provided to all outdoor install motors. 3.2 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 366 of 440
3.3	For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature	
4.0	<u>TYPE AND RATING</u>	
4.1	<u>A.C. MOTORS</u>	
4.1.1	Motors shall be general purpose, constant speed, squirrel cage, three phase, induction type.	
4.1.2	All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.	
4.1.3	The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.	
4.1.4	The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.	
4.1.5	All LT motors used in this project are proposed to be energy efficient type suitable for EFF1 efficiency rating.	
4.1.6	The motor name plate rating shall have at least 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipments at rated duty point. This clause is applicable, only vendor supplies motor along with load.	
4.1.7	Motors located in hazardous area shall be flame proof type.	
4.2	<u>D.C. MOTORS</u>	
4.2.1	D.C. Motor provided for emergency service shall be shunt/compound wound type.	
4.2.2	Motor shall be sized for operation with fixed resistance starter for maximum reliability.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 367 of 440

4. 2. 3 ~~Starter panel complete with all accessories shall be included in the scope of supply.~~

4. 3 For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature.

5.0 **PERFORMANCE**

5. 1 **RUNNING REQUIREMENTS**

5. 1. 1 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5. 1. 2 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5. 1. 3 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5. 1. 4 Motor shall not be stalled if the supply voltage drops to 70% of the rated voltage for 2 seconds duration.

5. 2 **STARTING REQUIREMENTS**

~~Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries except boiler feed pump where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above for HT motors~~

5. 2. 1 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage

5. 2. 2 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 368 of 440
be 75% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 85% rated voltage at motor terminals. 5.2.3 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition. Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day. Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction. 5.2.4 HT pump motors shall be suitable to start with forward rotation. 5.2.5 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage 5.3 <u>STRESS DURING BUS TRANSFER.</u> 5.3.1 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage. 5.3.2 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics. 5.4 <u>LOCKED ROTOR WITHSTAND TIME</u> 5.4.1 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 369 of 440
5.4.2	Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.	
5.4.3	Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilizing motor rated capacity	
6.0	<u>SPECIFIC REQUIREMENTS</u>	
6.1	<u>ENCLOSURE</u>	
6.1.1	All indoor motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified and outdoor motor enclosure shall confirm to degree of IPW-55. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.	
6.1.2	For hazardous area approved type of increased safety enclosure shall be furnished.	
6.2	<u>COOLING</u>	
6.2.1	The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).	
6.2.2	In case water cooling is required for very large motors, prior approval of the customer is to be obtained before proceeding ahead with design & manufacture.	
6.3	<u>WINDING AND INSULATION</u>	
6.3.1	All insulated winding shall be of copper.	
6.3.2	All motors shall have class F insulation but limited to class B temperature rise.	
6.3.3	Windings shall be impregnated to make them non-hygroscopic and oil resistant.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 370 of 440
6. 4 <u>TROPICAL PROTECTION</u> 6. 4. 1 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion. 6. 4. 2 All fittings and hardwares shall be corrosion resistant. 6. 5 <u>BEARINGS</u> 6. 5. 1 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. 6. 5. 2 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. 6. 5. 3 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area. 6. 5. 4 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves. 6. 5. 5 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. 6. 5. 6 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs. 6. 5. 7 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner. 6. 5. 8 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent. 6. 5. 9 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 371 of 440
6. 6	<u>NOISE & VIBRATION</u> 6. 6. 1 The noise level shall be as per statutory acceptance (IS/IEC). 6. 6. 2 The peak amplitude of the vibration shall be within IS/IEC specified limits.	
6. 7	<u>MOTOR TERMINAL BOX</u>	
6. 7. 1	Motor terminal box shall be phase segregated (PSTB) type and located in accordance with Indian Standards clearing the motor base- plate/ foundation.	
6. 7. 2	Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. For HT motors and 90 Deg. for LT motors unless otherwise approved.	
6. 7. 3	The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.	
6. 7. 4	The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.	
6. 7. 5	Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.	
6. 7. 6	The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.	
6. 7. 7	The terminal box shall be capable of withstanding maximum system fault current for duration of 0.25 sec.	
6. 7. 8	For 11kV and 33kV motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.	
6. 7. 9	Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.	
6. 7. 10	The gland plate for single core cable shall be non-magnetic type.	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 372 of 440

6.7.1.1 Due to any reason, if the terminal box is found to be not suitable for the approved cable size for either HT/LT motors, then the bidder shall arrange necessary adopter box to facilitate the termination of cables. The adopter box shall be of the same short circuit rating and specifications as the main terminal box. The adopter box shall be located as near as possible to the main terminal box. The interconnecting cabling between adopter box and main terminal box along with providing suitable cable glands and termination kits as applicable shall also be done by the bidder.

6.8 GROUNDING

6.8.1 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GS bolts and washer

6.8.2 The grounding connection shall be suitable for accommodation of ground conductors as follows :

Motor above 90 kW	: 75 x 10 mm GS Flat
Motor above 30 kW up to 90 kW	: 50 x 6 mm GS Flat
Motor above 5 kW up to 30 kW	: 25 x 6 mm GS Flat
Motor up to 5 kW	: 8 SWG GS Wire

6.8.3 The cable terminal box shall have a separate grounding pad

6.9 RATING PLATE

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

(a) Temperature rise in Deg.C under rated condition and method of measurement.

(b) Degree of protection.

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 373 of 440
(c) Bearing identification no. and recommended lubricant. (d) Location of insulated bearings. 6.10 CONSTRUCTION 6.10.1 Stator Core The Stator Core Lamination shall be made of high-grade silicon/magnetic steel sheet varnished on both sides and pressed to form rigid core. 6.10.2 Rotor The rotor construction shall be such that in case of dislodging of the rotor bar from the end ring, it should not come out and hit the stator core/stator winding and damage. 7.0 ACCESSORIES 7.1 GENERAL Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application 7.2 SPACE HEATER 7.2.1 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement. 7.2.2 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle. 7.3 TEMPERATURE DETECTORS 7.3.1 All 11kV and 3.3kV motors shall be provided with twelve (12) nos. Simplex type winding temperature detectors, four (4) nos. per phase.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 374 of 440
7.3.2 7.3.3 7.3.4 7.3.5 7.4 7.4.1 7.4.2 7.4.3 7.5 7.5.1	11kV and 3.3kV motor bearing shall be provided with duplex type temperature detectors. The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C. Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity. Five numbers of Temperature detectors / thermistors shall be provided for L.T. Motors above 90 kW (3 nos. Winding temperatures & 2 nos. bearing temperatures). <u>INDICATOR/SWITCH</u> Dial type local indicator with alarm contacts shall be provided for the following : (a) 11kV and 3.3kV motor bearing temperature (b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C. <u>CURRENT TRANSFORMER FOR DIFFERENTIAL PROTECTION</u> Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section - 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 375 of 440
7.5.2	The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.	
7.6	<u>ACCESSORY TERMINAL BOX</u>	
7.6.1	All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.	
7.6.2	Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.	
7.7	<u>DRAIN PLUG</u>	
	Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.	
7.8	<u>LIFTING PROVISIONS</u>	
	Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.	
7.9	<u>DOWEL PINS</u>	
	The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.	
7.10	<u>PAINTING</u>	
	Motor including fan shall be painted with corrosion proof paints of colour shade (RAL-7032).	
8.0	<u>TESTS</u>	
8.1	<u>ROUTINE AND TYPE TEST:</u>	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 376 of 440

Tests are to be conducted for ~~HT and~~ LT motors 60kW and above in presence of Mahagenco representative and contractor as per IS: 325 and required copies of test certificates are to be furnished for approval and despatch clearance. In addition, following tests shall have to be carried out on the motors in presence of MAHAGENCO representative & contractor on LT & HT motors. For Motors below 60kW type and routine test conducted as per IS325 shall be witnessed by contractor and test certificate shall be submitted for review of Mahagenco & Dispatch clearance

8 . 1 . 1 FOR HT MOTORS:

(a) Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-671/IS 14422,1995 test voltages as under

Voltage rating of motor	Impulse Test Voltage
3.3 kV	: 18 kV peak
11 kV	: 49 kV peak

(b) Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test

(c) Polarization Index Test as per IS:7816 as routine test

(d) Tan delta measurement on coils

(e) Surge withstand test for inter turn insulation.

(f) Test to diagnose rotor bar failure during manufacture.

Tests indicated at (d), (e), (f) shall be carried out during manufacture of the coils and shall be furnished for verification .

8 . 1 . 2 FOR HT & LT MOTORS:

(a) Test for suitability of IP55/ IPW- 55 as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test,

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 377 of 440
provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating. (b) Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box within last three years. (c) Test for noise level as routine test. (d) Test for vibration as routine test. (e) Overspeed test as type test. 8.2 <u>TEST WITNESS:</u> Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 378 of 440

CONSULTANT : PROCON ENGINEERS

		MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 10
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES		Page 379 of 440
<u>AC & DC MOTOR</u> <u>DATASHEET – A</u>			
SR. NO.	ITEM	UNIT	
1.0	<u>AUXILIARY POWER SUPPLY</u>		
1.1	<u>H.T. SUPPLY</u>		
	11kV, 3Ø, 3W, 50 Hz non-effectively earthed		Motors rated 1000 kW and above
	Fault level 44 kA symm		
	33kV, 3Ø, 3W, 50 Hz non-effectively earthed		Motors above 160 kW and below 1000kW
	Fault level 40 kA symm		
1.2	<u>L.T. SUPPLY</u>		
	415V, 3Ø, 3W, 50 Hz effectively earthed		Motors below and including 160kW
	Fault level 50 kA symm		
	240V, 1Ø, 2W, 50 Hz effectively earthed		Lighting, space heating, A.C. control & protective devices
1.3	<u>D.C. SUPPLY</u>		
	220V, 2W, unearthed		D.C. alarm, control & protective devices
	Fault level 25* kA.		
Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation			
2.0	<u>RANGE OF VARIATION</u>		

CONSULTANT : PROCON ENGINEERS

		MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section - 10
REV: R0		ELECTRICAL EQUIPMENT & ACCESSORIES	Page 380 of 440
SR. NO.	ITEM	UNIT	
2.1	<u>A.C. SUPPLY:</u>		
	Voltage		± 10%
	Frequency		± 5%
	Combined Voltage & frequency		± 10% (absolute sum)
	During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance		
2.2	<u>D.C. SUPPLY</u>		
	Voltage		198 to 240 Volt -15% to +10%

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